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## MEMORANDUM

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**To:** Jason Gunter, U.S. Environmental Protection Agency  
**From:** Marcia Greenblatt  
**Date:** February 2014  
**Subject:** Big River OU-2 Visual Railroad Bed Survey  
**Project No.:** C816

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There are approximately 40 miles of active and 70 miles of historical railroad in St. Francois County (NewFields 2007a). The older railroads were constructed with chat and rock from the early lead mining operations. Railroad grades on side slopes were constructed using the cut and fill method with a final cover consisting of 12–18 in. of chat. A thin layer of chat ballast was placed in flat “cut” sections through hills and where the grade was constructed on existing topography. Fill was used across low-lying areas, at stream crossings, and where it was necessary to construct ramps to crest a divide (NewFields 2007a). Historical railroad beds that are subject to erosion and are close to Big River or its tributaries could be contributing sediments and mining-related material to Big River.

A visual survey of railroad beds was performed December 5th and 6th, 2012 to support the ongoing feasibility study in OU-2 (river and non-residential areas) of St. Francois County Mining Area (also referred to as Big River Mine Tailings Site), Missouri. The railroad bed survey was performed to support the identification and evaluation of potential remedial alternatives. The primary objective of the visual railroad bed survey was to identify and delineate areas of eroded chat from railroad beds that may be an ongoing source of mining-related material to Big River and its tributaries. The proposed approach of the visual railroad bed survey was documented in the Field Sampling Proposal (FSP), Appendix A of the Quality Assurance Project Plan (QAPP) (Integral 2013a).

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## **SUMMARY OF VISUAL RAILROAD BED SURVEY ACTIVITIES**

A visual survey of the historical railroad beds and crossings was performed to characterize railroad beds that may be providing an ongoing source of mining-related material to Big River and its tributaries in OU-2. Railroads in the Big River watershed that may be impacting Big River or its tributaries were qualitatively inspected for evidence of ongoing erosion. The extent of the survey was determined by review of Visual River Survey (VRS) observations, mapped railroad locations, and an aerial photo evaluation (Integral 2013b).

### **Site Selection**

The visual railroad bed survey was performed at 19 locations along Big River and tributaries within St. Francois County where the railroad beds were identified as being within approximately 50 ft of Big River or a tributary (Figure 1, Table 1). To identify potential survey locations, railroad beds (NewFields 2006) and waterbodies were mapped in geographic information systems (GIS). A 50-ft buffer was delineated around the railroad beds and locations where the railroad buffer overlapped with a waterbody were identified for the survey. The approach was to survey areas within 50 ft of the waterways, however, several surveyed areas identified initially were actually farther than 50 ft. The historical railroad GIS shapefile is low in resolution and presents some uncertainty as to the distance from the railroad to a waterbody; this resulted in some of the surveyed areas being farther than the target distance from the waterbody. Over the course of the field activity, an additional area of historical railroad bed erosion was observed and assigned the sample name "HRR Berm Breach."

### **Field Approach**

At each survey location the field team visually inspected the railroad bed for evidence of erosion. Detailed notes, sketches, and photographs were collected to document the conditions of the railroad bed and the location and extent of any observed erosional areas (Integral 2013c). Point, line, and polygon features were logged with a differential global positioning (DGPS) unit to delineate the location and extent of any erosional features. In some survey locations, additional measurements were made of the erosional areas using an open reel tape measure.

### **Data Evaluation**

The data collected in the visual railroad survey were used to identify areas of historical and recent erosion, estimate sediment volumes of eroded areas, and confirm the distance of the

eroded areas to the adjacent river or creek. In locations where additional measurements were made using an open reel tape measure, volume estimates of eroded railroad bed material were developed based on cross-section geometry of the eroded area. The point, line, and polygon features logged by the survey teams were imported into GIS and Google Earth Pro. The distance from observed eroded areas to the nearest water body was verified using Google Earth Pro, which in some instances provided higher resolution aerial photography of the surveyed sites.

## **Results**

Survey sites were evaluated to characterize the extent of exposed and eroded railroad bed material as well as the distance of erosional areas to the nearest water body (Table 2). Evidence of ongoing erosion was not observed at the majority of the surveyed railroad beds (Table 2). At several survey sites the observed erosional areas were greater than 50 ft from the waterbody and it is unlikely that eroded material enters the waterbody. Five of the nineteen surveyed sites presented evidence of ongoing erosion that has the potential to enter Big River tributaries.

### **Stable Railroad Bed Sites**

No evidence of erosion was observed at the majority of the historical railroad bed survey sites. Survey sites that were noted to have no evidence of erosion included HRR001, HRR002, HRR006, HRR007, HRR010, HRR013, HRR015, HRR016, and HRR019 (Table 2). A retaining wall and armoring have prevented eroded railroad bed material from reaching Big River at survey location HRR013. Vegetation was observed to cover the slope of railroad beds at survey sites HRR006 and HRR016. These observations are consistent with a previous survey of St. Francois County historical railroad beds, in which it was observed that most of the rail grades were overgrown or paved over and that for the most part the ballast appeared stable (NewFields 2007a).

Three railroad survey sites, HRR008, HRR017, and HRR018, presented evidence of past erosion but appeared to be in stable condition. Survey location HRR008 had a large slumped area in the slope of the railroad bed that has since filled in with mature trees and other plantings. An old breach was observed in the railroad bed at HRR017 but the slope was noted to be stable. A small, unnamed tributary passes through a former railroad bed at survey location HRR018, however, the man-made breach in the railroad bed was well graded and evidence of ongoing erosion was not observed. These three sites do not appear to be an ongoing source of mining related material to Big River or its tributaries.

### **Railroad Bed Sites with Ongoing Erosion**

Evidence of ongoing erosion was observed at seven of the nineteen railroad survey sites; the eroded areas at two of these sites were greater than 50 ft from the nearest waterway and do not appear to be ongoing sources of mining related material to Big River or its tributaries. Spatial extents were recorded for a breached railroad bed at survey location HRR-BermBreach, however, the observed eroded material is on flat farmland more than 100 ft from the nearest waterbody. The three erosional areas observed and measured at survey location HRR004 were greater than 50 ft from the tributary, which was dry at the time of the survey. The estimated volume of eroded material from HRR004 was less than 100 ft<sup>3</sup>. Given the distance to the tributary and small volume of material, it is unlikely that the railroad bed at HRR004 is a source of mining-related material to downstream waters. The survey locations where exposed and erosional areas of railroad beds may be an ongoing source of mining related material to Big River and its tributaries are discussed below.

#### ***Flat River Creek***

The remains of a former railroad trestle cross Flat River Creek at approximately river mile 5.3 (upstream of the confluence with Big River). A visual inspection of the trestle supports and the associated historic railroad bed was performed at survey location HRR003 (Figure 1). Erosion of the railroad bed along the eastern riverbank was observed; at the time of the survey eroded railroad bed material was not observed in Flat River Creek. An estimated 190 ft<sup>3</sup> of railroad bed material have eroded and this location may be an ongoing source of mining related material to Flat River Creek (Table 3).

#### ***Owl Creek***

Owl Creek passes beneath the abandoned Mississippi River and Bonne Terre (MR and BT) Railroad through a cement box culvert. The railroad crossing and Owl Creek culvert were investigated as part of this visual survey (Station ID HRR009; Figure 1). An erosional area of the railroad bed was observed on the bank to the northwest of the culvert. Exposed mining-related material was observed on the northeastern slope of the culvert but did not appear to be eroding into the creek. Erosion of the railroad crossing was not observed upstream of the box culvert.

The railroad bed area northwest of the culvert was noted to contain loose material that enters Owl Creek. Survey measurements were used to estimate that 190 ft<sup>3</sup> of material has eroded from this portion of the railroad bed (Table 3). These results were consistent with a previous survey of St. Francois historical railroad beds in which chat from the railroad bed

was observed to have eroded into the Owl Creek channel below the box culvert (NewFields 2007a). Results of sediment probing surveys performed in Owl Creek in 2007 and 2012 indicate that the volume of sediment in Owl Creek downstream of the railroad culvert has decreased over time (NewFields 2007b; Integral 2013d). The observed decrease in sediment volume suggests a declining impact from the railroad bed box culvert.

The calculated volume of eroded material from the northwestern portion of the railroad culvert, 7 yd<sup>3</sup>, is orders-of-magnitude lower than the Owl Creek sediment volume estimates from the 2007 and 2012 probing surveys (NewFields 2007b; Integral 2013d). In 2007, the total estimated sediment volume in Owl Creek was 3,650 yd<sup>3</sup> from the railroad culvert to the confluence with Big River, approximately 1,200 ft downstream (NewFields 2007b). Data from the 2012 sediment probing survey were used to estimate a volume of 1,660 yd<sup>3</sup> of sediment in this reach (Integral 2013d). The difference between estimated Owl Creek sediment volumes and eroded railroad bed material volume suggests that the railroad bed is a minor source of material to lower Owl Creek.

### ***Turkey Creek***

An abandoned railroad bed runs parallel to Turkey Creek from the Bonne Terre piles to the Big River confluence, a distance of approximately 3 miles (Figure 1). A section of railroad nearest the western Bonne Terre pile was surveyed in 2007; the top portion of the bed was characterized as chat (NewFields 2007a). Minor erosion of the railroad bed nearest Bonne Terre was noted during the 2007 sediment probing survey; however, sediment probing was not performed in Turkey Creek at that time because the volume appeared to be too small to measure (NewFields 2007b).

Exposed railroad bed material and eroded areas were observed at two survey sites along Turkey Creek, HRR011 and HRR012 (Table 2). The spatial extents of fifteen eroded areas along the railroad bed at HRR012 and one area at HRR011 were logged with a DGPS unit. The eroded areas slope downward onto the eastern bank of Turkey Creek, about 30 ft below. Depth measurements were not performed; however, a rough estimate of greater than 4,200 ft<sup>3</sup> of lost material was calculated from the measured surface area of the eroded areas and an assumed depth of 0.5 ft (Table 3). Several of the eroded areas at HRR012 were larger than any other observed during the survey and the railroad bed at HRR012 may be an ongoing source of material to Turkey Creek.

### ***Bee Run***

Exposed and erosional areas were observed at survey location HRR014, the site of an abandoned railroad bridge that crosses the tributary Bee Run (Figure 1). Off road vehicle

tracks were observed on the western slope of the railroad bed and may have led to the erosion of the railroad bed at this location. An erosional area on the eastern slope of HRR014 was observed to fan into Bee Run. Field measurements and an assumed depth of 0.5 ft were used to estimate that approximately 920 ft<sup>3</sup> of material had eroded from railroad beds that are within 50 ft of Bee Run, and it may be a minor ongoing source of material to the tributary.

## Summary

Historical railroad crossings and railroad beds within approximately 50 ft of Big River and its tributaries were visually inspected for evidence of ongoing erosion. The majority of the surveyed railroad crossings and railroad beds appeared stable or unlikely to be an ongoing source of material to the Big River watershed. Erosional areas within 50 ft of a waterbody were observed at 5 of the 19 survey locations: HRR003, HRR009, HRR011, HRR012, and HRR014. The observed erosional areas from these survey locations are situated on or directly above riverbanks and constitute an active source of railroad bed material to the stream below.

Comparisons of eroded railroad bed material volume estimates with results from sediment probing surveys suggest the historical railroad beds are a relatively minor source of material to the Big River watershed, as the estimated volumes of eroded material are orders-of-magnitude lower than estimated volumes of sediment in Big River and its tributaries. For example, an estimate of Big River in-channel sediment from river mile 108 (at Eaton Branch) to river mile 86, downstream of Turkey Creek, was over a million cubic yards (NewFields 2007b). This survey indicates that chat eroding from historical railroad beds could, at most, account for only a very small proportion of the total sediment volume.

## REFERENCES

Integral. 2013a. Field sampling plan, river and non-residential areas (OU-2) St. Francois County mining area, Missouri. Appendix A to the quality assurance project plan, river and non-residential areas (OU-2) St. Francois County Mining Area, Missouri. Prepared for The Doe Run Resources Corporation, St. Louis, MO. Integral Consulting Inc., Seattle, WA.

Integral. 2013b. Visual river survey technical memorandum, river and non-residential areas (OU-2) St. Francois County Mining Area, Missouri. Prepared for The Doe Run Resources Corporation, St. Louis, MO. Integral Consulting Inc., Seattle, WA.

Integral. 2013c. Field sampling report, river and non-residential areas (OU-2) St. Francois County Mining Area, Missouri. Prepared for The Doe Run Resources Corporation, St. Louis, MO. Integral Consulting Inc., Seattle, WA.

Integral. 2013d (In preparation). Sediment probing survey technical memorandum, river and non-residential areas (OU-2) St. Francois County Mining Area, Missouri. Prepared for The Doe Run Resources Corporation, St. Louis, MO. Integral Consulting Inc., Seattle, WA.

NewFields. 2006. Focused remedial investigation for mined areas in St. Francois County, Missouri. March 3, 2006.

NewFields. 2007a. Historic railroads, St. Francois County Mined Areas, St. Francois County, Missouri. January 29, 2007.

NewFields. 2007b. Volume of sediments in Big River, Flat River Creek, and Owl Creek. Prepared for The Doe Run Resources Corporation, St. Louis, MO. NewFields, Denver, CO.

Owen, M.R., Pavlowsky R.T., and D.J. Martin. 2012. Big River Borrow Pit monitoring project. Big River Mining Sediment Project. Funded by U.S. Fish and Wildlife Service and Cooperative Ecosystems Studies Unit. Prepared by the Ozarks Environmental and Water Resources Institute, Missouri State University, Springfield, MO.

## **LIST OF ATTACHMENTS**

Figure 1. Visual Railroad Bed Survey Results

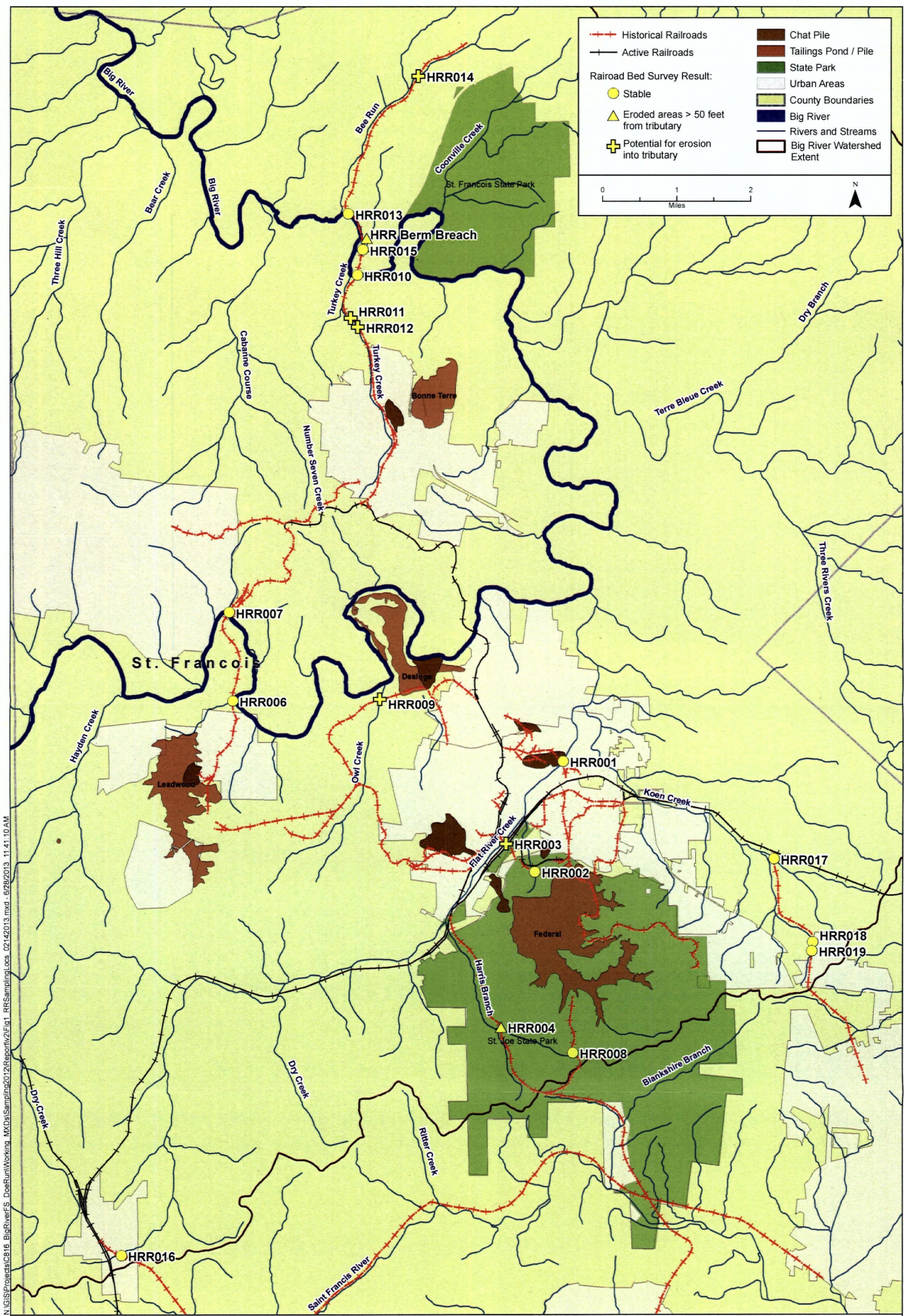
Table 1. Visual Railroad Bed Survey Locations

Table 2. Summary of Results of Visual Railroad Bed Survey

Table 3. Estimated Volumes of Eroded Material from Surveyed Railroad Beds

Attachment A. Photo Log

## FIGURES



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**Figure 1.**  
Visual Railroad Bed Survey Results  
River and Non-Residential Areas (OU-2)  
St. Francois County Mining Area, Missouri

## **TABLES**

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Table 1. Visual Railroad Bed Survey Locations

Station ID <sup>a</sup>	Longitude <sup>b</sup>	Latitude <sup>b</sup>
HRR001	-90.507524068	37.858654836
HRR002	-90.515239228	37.837208319
HRR003	-90.522135786	37.842912613
HRR004	-90.524584101	37.807000394
HRR006	-90.588813391	37.872307868
HRR007	-90.589135985	37.889678887
HRR008	-90.507016460	37.801620142
HRR009	-90.552415483	37.871872157
HRR010	-90.555226977	37.954865940
HRR011	-90.557214088	37.946492295
HRR012	-90.555502419	37.944700557
HRR013	-90.557090191	37.966853662
HRR014	-90.538805098	37.993396738
HRR015	-90.553699012	37.959771557
HRR016	-90.619882113	37.764288467
HRR017	-90.456127606	37.838506793
HRR018	-90.447090762	37.822013460
HRR019	-90.447365269	37.820288213
HRR Berm Breach	-90.553524447	37.960367701

Notes:

<sup>a</sup> Coordinates for target survey locations are presented. At some locations multiple discrete eroded areas were observed.

<sup>b</sup> Coordinates in World Geodetic System 1984.

Table 2. Summary of Results from Visual Railroad Bed Survey

Station ID	Nearest Water Body	Distance from Station to Water Body <sup>a</sup>	Actively eroding areas?	Observations
HRR001	Flat River Creek	< 50 feet	No	Railroad bed appeared stable
HRR002	Shaw Branch	< 100 feet	No	Railroad bed appeared stable
HRR003	Flat River Creek	< 30 feet	Yes	Exhibited potential for ongoing erosion
HRR004	Intermittent tributary to Harris Branch	approximately 100 feet	Yes	Exhibited potential for ongoing erosion; site is greater than 50 feet from tributary.
HRR006	Eaton Branch	Trestle over river	No	Railroad bed appeared stable
HRR007	Big River	< 100 feet	No	Railroad bed appeared stable
HRR008	Intermittent tributary to Harris Branch	< 50 feet	No	Railroad bed appeared stable
HRR009	Owl Creek	Owl Creek culvert is beneath railroad bridge	Yes	Exhibited potential for ongoing erosion
HRR010	Big River	Railroad trestle crosses Big River	No	Railroad bed appeared stable
HRR011	Turkey Creek	approximately 50 feet	Yes	Exhibited potential for ongoing erosion
HRR012	Turkey Creek	approximately 50 feet	Yes	Exhibited potential for ongoing erosion
HRR013	Big River	< 100 feet	No	Railroad bed appeared stable
HRR014	Bee Run	< 20 feet	Yes	Exhibited potential for ongoing erosion
HRR015	Perennial trib. to Big River	< 200 feet	No	Railroad bed appeared stable
HRR016	Intermittent tributary to head of Flat Ri	< 50 feet	No	Railroad bed appeared stable
HRR017	Koen Creek	< 50 feet	No	Railroad bed appeared stable
HRR018	Intermittent stream to Koen Creek	Stream passes through breach in railroad bed	No	Railroad bed appeared stable
HRR019	Intermittent stream to Koen Creek	> 300 feet	No	Railroad bed appeared stable
HRR Berm Breach	Perennial tributary to Big River	> 150 feet	No	Exhibited potential for ongoing erosion; site is greater than 50 feet from tributary.

Note:

<sup>a</sup> Distances were obtained from field-collected GPS data and Google Earth Pro.

Table 3. Estimated Volumes of Eroded Material from Surveyed Railroad Beds

Station ID	Nearest Water Body	Survey Notes	Estimated Volume of Eroded Railroad Bed Material (ft <sup>3</sup> )
HRR003	Flat River Creek	On eastern bank of Flat River Creek	190
HRR009	Owl Creek	Northwest of culvert	190
HRR011	Turkey Creek	One eroded area observed	100 <sup>a</sup>
HRR012	Turkey Creek	Fifteen eroded areas observed	4,100 <sup>a</sup>
HRR014	Bee Run	Six eroded areas observed	920 <sup>a</sup>

Note:

<sup>a</sup> Volume estimated from measured surface area of erosional area(s) and an assumed depth of 0.5 feet.

**ATTACHMENT A**

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**PHOTO LOG**

*(FOUND ON ACCOMPANYING DISC)*



Photo 1: HRR001. Former trestle location over Flat River Creek



Photo 2: HRR002. Stable railroad bed



Photo 3: HRR003. Former trestle location over Flat River Creek



Photo 4: HRR004. Paved railroad bed with eroded areas on northwest slope



Photo 5: HRR006. Vegetated railroad bed and banks near former trestle crossing Eaton Branch

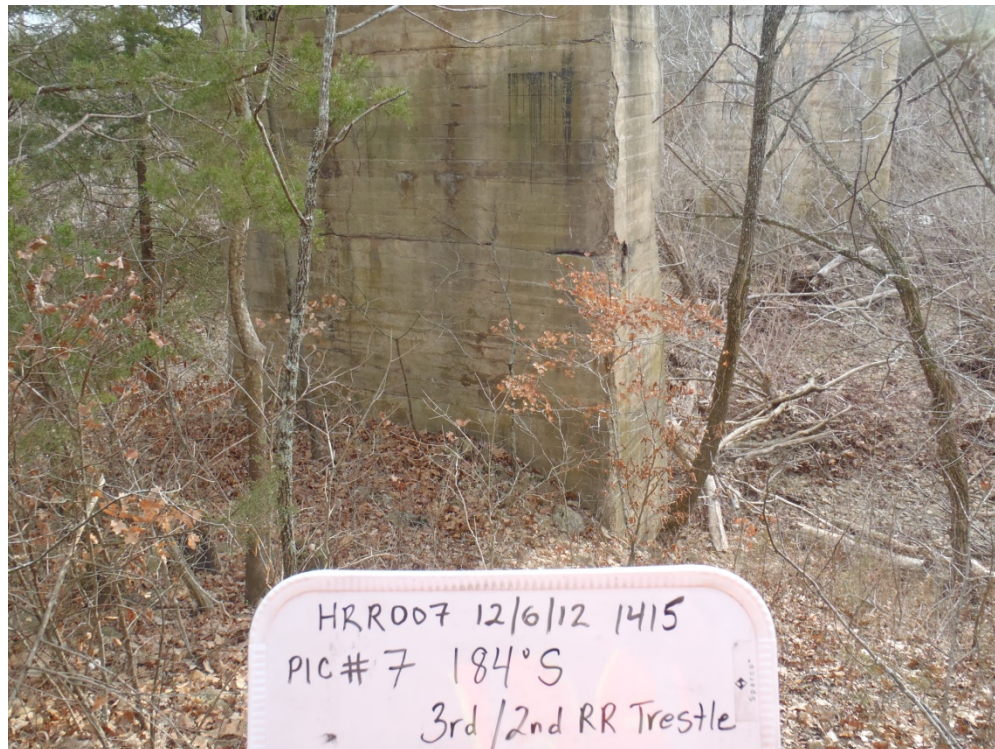


Photo 6: HRR007. Vegetated bank near former trestle crossing Big River



Photo 7: HRR008. Vegetated railroad bed above intermittent tributary to Harris Branch



Photo 8: HRR009. Former railroad in foreground with Owl Creek below, facing downstream



Photo 9: HRR009. Eroded railroad bed on northwest slope of Owl Creek culvert

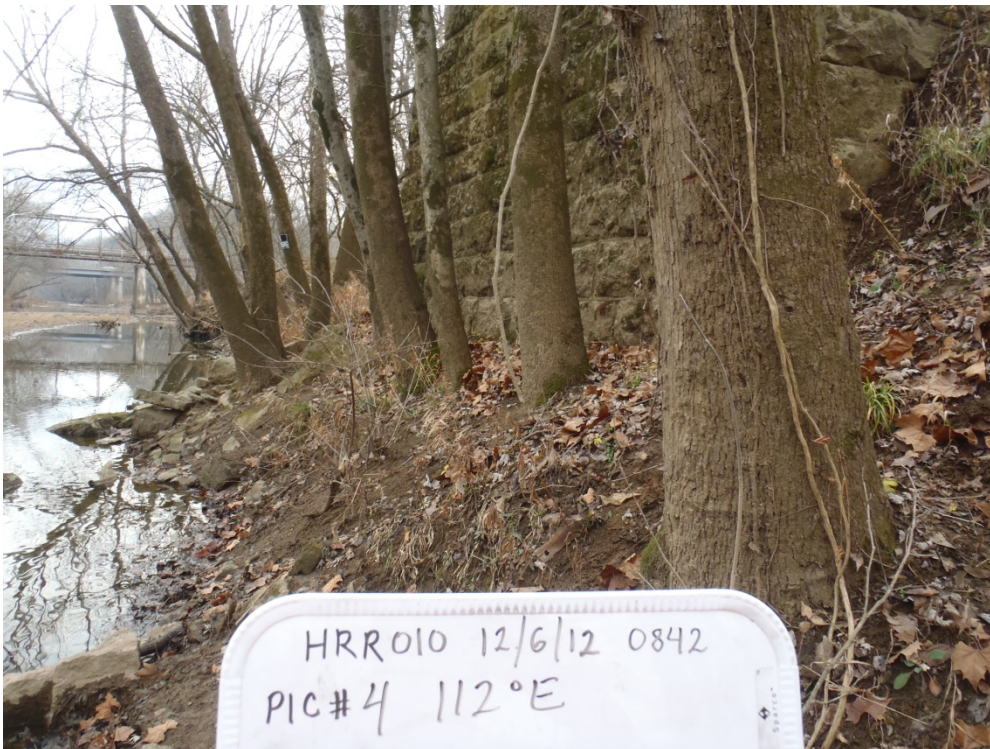


Photo 10: HRR010. Former trestle crossing Big River



Photo 11: HRR011. Eroded areas on railroad bed slope facing Turkey Creek



Photo 12: HRR012. Eroded areas on railroad bed slope facing Turkey Creek



Photo 13: HRR012. Eroded area on railroad bed slope; Turkey Creek at base of slope



Photo 14: HRR013. Vegetated railroad bed slope leading to Big River



Photo 15: HRR014. Top of railroad bed above Bee Run



Photo 16: HRR014. Eroded area leading to Bee Run



Photo 17: HRR015. Former trestle above perennial tributary to Big River



Photo 18: HRR016. Vegetated railroad bed slope on culvert for intermittent tributary to Flat River Creek



Photo 19: HRR017. Remains of railroad bed near Koen Creek



Photo 20: HRR018. Tributary to Koen Creek passing through stable railroad berm



Photo 21: HRR019. Remains of railroad bed near tributary to Koen Creek



Photo 22: HRR Berm Breach. Breach in railroad bed crossing a field near a Big River tributary